



**Mechanical and  
Aerospace Engineering**



# **MAE Student Handbook 2020-2021**

**MECHANICAL ENGINEERING  
AEROSPACE ENGINEERING  
ENVIRONMENTAL ENGINEERING**

[mae.ucsd.edu](http://mae.ucsd.edu)

# Welcome to the Mechanical and Aerospace Engineering Department

Congratulations on being admitted to the Department of Mechanical and Aerospace Engineering (MAE) in the Jacobs School of Engineering. We are sure you have questions about what to do next. We hope that this handbook will help you get familiar with our department's policies and expectations. If there are questions or concerns that are not answered, please feel free to contact us.

## MAE Undergraduate Academic Advising

The MAE advising staff assists students with their programs of study. The advising staff is available in EBU II, first floor for advising.

### Chad Baldwin

(Last names A-L)

(858) 534-0114, [chbaldwin@ucsd.edu](mailto:chbaldwin@ucsd.edu)

### Nadia Espinoza

(Last names M-Z)

(858) 822-2035, [nlespinoza@ucsd.edu](mailto:nlespinoza@ucsd.edu)

### **Walk-in Advising:**

Monday 1:30 PM - 3:00 PM

Tuesday 1:30 PM - 3:00 PM

Thursday 9:00 AM - 11:30 AM

Friday 9:00 AM - 11:30 AM

### **Appointment Advising:**

Monday 9:00 AM - 11:30 AM

Tuesday 9:00 AM - 11:30 AM

Wednesday 9:00 AM - 11:30 AM

Thursday 1:30 PM - 3:00 PM

Friday 1:30 PM - 3:00 PM

- Due to COVID 19 – academic advising can be arranged via **Zoom**

*The MAE advising program runs parallel to the work of college advisors who assist students with the general education requirements of each college.*

[mae-ugradadm@eng.ucsd.edu](mailto:mae-ugradadm@eng.ucsd.edu)

## MAE PROGRAM EDUCATIONAL OBJECTIVES

### EDUCATIONAL OBJECTIVES

- To provide our students with a strong technical education that will enable them to have successful careers as engineers, technology leaders and innovators.
- To prepare our students for rapid technological change with the core knowledge central to assuring that they are able to further develop their knowledge and skills across a range of disciplines throughout their professional careers and pursue advanced education.
- To prepare our students to communicate and work in teams effectively and to deal knowledgeably and ethically with the impact of technology in our society and on global issues.

### MISSION STATEMENT

*"Educate Tomorrow's Technology Leaders.  
Conduct Leading Edge Research and Drive Innovation.  
Transfer Discoveries for the Benefit of Society."*

*"To foster the best possible working and learning environment, our university strives to maintain a climate of fairness, cooperation, and professionalism, which is embodied in our campus Principles of Community. UC San Diego embraces diversity, equity, and inclusion as essential ingredients of academic excellence in higher education."*



## **OUTCOMES (ABET accredited programs)**

### **AEROSPACE ENGINEERING STUDENT OUTCOMES:**

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- An ability to communicate effectively with a range of audiences
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- Knowledge of aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control
- Knowledge of attitude determination and control, space structures, orbital mechanics, and rocket propulsion
- An ability to integrate knowledge of the fundamental topics in the design of aerospace systems

### **MECHANICAL ENGINEERING STUDENT OUTCOMES:**

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively with a range of audiences.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
- An ability to work professionally in mechanical systems areas.
- An ability to work professionally in thermal systems areas.
- An ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations).
- An ability to model, analyze, design, and realize physical systems, components or processes.

## WHAT IS ABET?

### **ABET (Accreditation Board for Engineering and Technology)**

**All majors at USCD are accredited by the Western Association of Schools and Colleges (WASC).**

ABET is responsible for the **specialized accreditation** of educational programs in applied science, computing, engineering, and technology.

ABET accreditation is assurance that a college or university program meets the quality standards established by the profession for which it prepares its students. For example, an accredited engineering program must meet the quality standards set by the engineering profession. An accredited computer science program must meet the quality standards set by the computing profession.

The quality standards that a program must meet in order to be ABET-accredited are set by the ABET professions themselves. This is made possible by the collaborative efforts of many different professional and technical societies. These societies and their members work together through ABET to develop the standards, and they provide the professionals who evaluate the programs to make sure they meet those standards.



## DURING THE FIRST YEAR

By the end of the first year, all students must complete at least the following required courses. These courses can be taken at UCSD or transferred in from a different university or community college.

<b>One introductory course</b>	<b>Three Math Courses</b>	<b>Two Physics Courses</b>	<b>General Chemistry</b>
<ul style="list-style-type: none"> <li>• MAE 3 (For ME)</li> <li>• MAE 2 (For AE)</li> <li>• MAE 21 (for AE)</li> </ul>	<ul style="list-style-type: none"> <li>• Math 20A</li> <li>• Math 20B</li> <li>• Math 20C</li> </ul>	<ul style="list-style-type: none"> <li>• Physics 2A</li> <li>• Physics 2B</li> </ul>	<ul style="list-style-type: none"> <li>• Chem 6A</li> <li>• Chem 6B (for EE)</li> <li>• Chem 6C (for EE)</li> </ul>

### Average GPA, MSAT and TSAT Scores of Students Admitted Directly to MAE Majors (2017):

	Fall 2017		
	M.SAT	SAT	GPA
<b>Aerospace</b>	690	1981	4.2
<b>Mechanical</b>	689	1960	4.2
<b>Environmental</b>	648	1834	4.2

## MAJOR ACADEMIC ADVISING

### MAE Undergraduate Advising Staff

The MAE advising staff assists students with their programs of study.

**Walk-in Advising:**      **Monday, Tuesday from 1:30 PM – 3:00 PM**  
**Thursday, Friday from 9:00 AM – 11:30 AM**

**Appointment Advising:** **Monday, Tuesday, Wednesday from 9:00 AM – 11:30 AM**  
**Thursday, Friday from 1:30 PM – 3:00 PM**

The MAE advising staff also assists students in preparing petitions to the Undergraduate Affairs Committee for any deviation from the standard programs of study. The MAE advising program runs parallel to the work of college advisors who assist students with the general education requirements of each college. It is important that the scheduling of mathematics, physics, chemistry and engineering courses be done as suggested in the MAE curriculum table. If you have any questions about your major, please see your MAE advisor.

**Student Affairs Lobby.** The student lobby is a great resource for students. Here you'll find copies of MAE major three/four-year plans, along with a complete list of technical electives for each major. The MAE Student Affairs lobby is located in EBU II, first floor.

## GENERAL EDUCATION/COLLEGE REQUIREMENTS

For graduation each student must satisfy general education (GE) course requirements determined by the student's college as well as the major requirements determined by the department. The six colleges at UCSD require widely different general education courses and the number of such courses differs from one college to another. Each college is unique in terms of student culture and the breadth of general education.

In practice, the overwhelming majority of students are happy with their college assignment, even if it was not their first choice originally, and few students apply to switch. Petitions to transfer between colleges are difficult to justify and are approved only in exceptional cases. To qualify, you must complete your originally assigned college's writing program, demonstrate that switching to a different college will substantially shorten your time to degree, and have a cumulative grade point average of at least 2.5 with a certain number of completed units. For more information about this, please contact your college advisor.

Each MAE program allows for general education courses so that students can fulfill their college requirements. In the ABET accredited programs, students must develop a program that includes a total of at least twenty-four units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. It should be noted, however, that some colleges require more than the nine or ten GE courses indicated in the curriculum tables. Accordingly, students in these colleges could take longer to graduate than four years. Students must consult with their college to determine which GE courses to take.

A guide to the number of college general education courses in addition to those met within MAE major programs:		
	# of Courses	# of Units
<b>Warren</b>	10	40
<b>Marshall</b>	10-	40-
<b>Muir</b>	11	44
<b>Sixth</b>	12-	52-
<b>ERC</b>	10-	44-
<b>Revelle</b>	12-	52-

*Unit of GEs range between 4-6 units per course*

## MAE MAJOR PROGRAMS AND REQUIREMENTS

Specific course requirements for each major program are outlined in tables in this section of the handbook. In addition to the required technical elective (TE) courses specifically indicated, a suggested scheduling of general education (GE) courses are distributed in the curricula for students to use to meet college general education requirements. To graduate, students must maintain an overall GPA of at least 2.0, and the Department requires all major requirement courses to be taken for a letter grade. A complete list of technical electives for each major is available on our website and in the MAE Student Affairs lobby (EBU II, first floor). In the accredited programs, TE courses are restricted to meet ABET standards. Students are encouraged to complete lower and upper-division courses as suggested in the curriculum tables in a timely fashion and in the sequences outlined.

**We STRONGLY discourage students deviating from their three/four-year plan when taking MAE upper-division courses.**

Lower-division courses are offered more than once each year to permit students some flexibility in their program scheduling. However, **many MAE upper-division courses are taught only once per year**, and courses are scheduled to be consistent with the curriculum as shown in the tables. Students taking upper-division courses in a different order than that shown in the tables may experience conflicts as the meeting times of different courses may overlap. A tentative schedule of course offerings is available from the department each spring for the following academic year. **Courses with a letter grade of F must be repeated before you can move on to the next course in the sequence.** Prerequisites are strictly enforced by the department.

## **CAPPED MAJORS**

Due to high demand, ALL engineering majors at the Jacobs School have been designated as oversubscribed and have been granted capped status as of Fall 2014.

- 1. Mechanical Engineering** (Effective Fall 2009 for freshmen. Effective Fall 2011 for transfers)
- 2. Aerospace Engineering** (Effective Fall 2009 for freshmen. Effective Fall 2011 for transfers)
- 3. Environmental Engineering** (Effective Fall 2014 for freshmen. Effective Fall 2015 for transfers)

### **Acceptance into an Engineering Major**

Acceptance into an engineering major is based on academic excellence demonstrated in high school, community college or other four-year institutions.

Admitted students that have applied to a capped major will be further evaluated by the Office of Admissions and Relations with Schools for admission to the major. Acceptance will be granted up to the maximum number of students in each of these capped major programs. Students who are not admitted to the capped major are placed into the alternate major selected on the UC Undergraduate Application, provided the alternate is not capped.

Students who would like to apply to switch into a capped MAE Engineering major must (1) complete at least one year of academic study at UC San Diego, (2) meet the minimum requirements to apply, and (3) submit an online application through the [JSOE Capped Major Application](#) system during an application period. For more information, please contact MAE Student Affairs.

### **Freshmen**

We highly recommend that freshman applicants list a non-capped open major as their alternate choice on the UC Undergraduate Application. If a student lists a capped major as both the first and alternate choices on the UC application and is not admitted to the first choice major, the Office of Admissions and Relations with Schools will place the student in the Undeclared major. The Undeclared major is not affiliated with the Jacobs School of Engineering. However, students admitted as undeclared may later seek admission to an engineering major.

### **Transfers**

We highly recommend that transfer applicants who list a capped engineering major as their first major, choose a non-capped engineering major or non-engineering major as their alternate choice. If a student lists an oversubscribed major as both the first and alternate choices on the UC application and is not admitted to the first choice major, the Office of Admissions and Relations with Schools will place the student in the Undeclared major. The Undeclared major is not affiliated with the Jacobs School of Engineering.

It is **strongly recommended** that transfers complete the following preparation for all engineering majors.

- Calculus I—for Science and Engineering (Math 20A)
- Calculus II—for Science and Engineering (Math 20B)
- Calculus and Analytic Geometry (Math 20C)
- Differential Equations (Math 20D)
- Linear Algebra (Math 18)
- Complete calculus-based physics series with lab experience (Physics 2A, B, and C)
- Chemistry 6A
- MATLAB programming course if available



# **AEROSPACE ENGINEERING**

Aerospace engineering is a four-year curriculum that begins with fundamental engineering courses in mechanics, thermodynamics, materials, solid mechanics, fluid mechanics, and heat transfer. Additional courses are required in aerospace structures, aerodynamics, flight mechanics, propulsion, controls, and aerospace design. Graduates of this program normally enter the aerospace industry to develop aircraft and spacecraft, but also find employment in other areas that use similar technologies, such as mechanical and energy-related fields. Examples include automobile, naval, and sporting equipment manufacturing. This program received ABET accreditation in 2002.

***This four-year plan is tentative and should be used as a guide.  
Please refer to the MAE website for the most updated curriculum plan.***

## **FRESHMEN FOUR YEAR PLAN**

<u>FALL QUARTER</u>	<u>WINTER QUARTER</u>	<u>SPRING QUARTER</u>
<b>Year 1</b>		
Math 20A	Math 20B	Math 20C
MAE 2-Intro to Aerospace	Phys 2A	Phys 2B
Chem 6A	GE	GE
GE (College Requirement)	GE	GE
<b>Year 2</b>		
Math 20D	Math 18	Math 20E
Phys 2C + Phys 2CL	MAE 8 - Intro to MatLab	MAE 131A - Solid Mechanics
MAE 21 - Aerospace Materials Science	MAE 30A - Kinematics	MAE 30B - Dynamics and Vibrations
GE	GE	GE
<b>Year 3</b>		
MAE 105 - Mathematical Physics	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 11 -Thermodynamics	MAE 143A - Signals and Systems	MAE 143B - Linear Control
MAE 180A - Spacecraft Guidance	TE - (Technical Elective)	MAE 170 - Experimental Technique
MAE 107 - Computational Methods	SE 160A - Aerospace Structural Mechanics I	SE 160B - Aerospace Structural Mechanics II
<b>Year 4</b>		
MAE 101C - Heat Transfer	MAE 155A - Aerospace Design	MAE 155B- Aeronautics Design
MAE 104 - Aerodynamics	MAE 175A - Engineering Lab	GE
GE	MAE 142 - Dynamics and Controls	GE
GE	MAE 113 - Propulsion	TE

**WHEN SCHEDULING CLASSES, THE MAE DEPARTMENT FOLLOWS THIS CURRICULUM GRID. IF YOU CHOOSE TO DEVIATE FROM IT, YOU WILL EXTEND YOUR TIME TO GRADUATION.**

## TRANSFER THREE YEAR PLAN

AEROSPACE ENGINEERING		
FALL	WINTER	SPRING
<b>Year 1</b>		
MAE 2 -Intro to Aerospace	Math 20E	MAE 131A- Solid Mechanics
MAE 8 - Intro. to MatLab	MAE 30A - Kinematics	MAE 30B - Dynamics and Vibrations
MAE 21 – Aerospace Materials Science	GE – (College Requirement)	GE
	GE	GE
<b>Year 2</b>		
MAE 105 - Mathematical Physics	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 107 - Computational Methods	MAE 143A - Signals and Systems	MAE 143B - Linear Control
MAE 11 -Thermodynamics	TE - (Technical Elective)	MAE 170 - Experimental Technique
MAE 180A - Spacecraft Guidance	SE 160A - Aerospace Structural Mechanics I	SE 160B – Aerospace Structural Mechanics II
<b>Year 3</b>		
MAE 101C - Heat Transfer	MAE 155A - Aerospace Design	MAE 155B- Aeronautics Design
MAE 104 - Aerodynamics	MAE 175A - Engineering Lab	GE
GE	MAE 142 - Dynamics and Controls	GE
GE	MAE 113 - Propulsion	TE

**This academic plan assumes that you have completed all of the following courses at your previous college:**

Calculus I for Science and Engineering (MATH 20A), Calculus II for Science and Engineering (MATH 20B), Calculus and Analytic Geometry (MATH 20C), Differential Equations (MATH 20D), Linear Algebra [MATH 18], Complete calculus-based physics series (PHYS 2A, B, C), and general chemistry (CHEM 6A).

### AEROSPACE ENGINEERING

In fulfilling the General Education (GE) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Eight GE courses are listed here; individual college requirements may be higher or lower.

Technical Elective (TE) courses must be upper-division or graduate courses in the engineering sciences, natural sciences or mathematics and must be selected with prior approval of the Department. See the MAE website for a complete list of pre-approved Technical Electives.

# ENVIRONMENTAL ENGINEERING

The Environmental Engineering program resembles the Chemical Engineering program for the first two years. In the third and fourth year, the programs diverge: an environmental engineering sequence is offered, as well as further specialization in fluid mechanics, and a wide choice of Technical Elective (TE) courses, both from within MAE and in other departments. The Environmental Engineering program is a modern interpretation of this rapidly changing field. Unlike the classical environmental engineering topics (e.g. water sanitation, brownfield remediation), many new environmental engineering and sustainability challenges require strong quantitative skills. Renewable energy technologies require skills in material science and physics, climate change research requires individuals trained in fluid mechanics, and environmental transport and sustainable building design requires deep knowledge of heat and mass transfer in complex geometries.

***This four-year plan is tentative and should be used as a guide.***  
***Please refer to the MAE website for the most updated curriculum plan.***

## FRESHMEN FOUR YEAR PLAN

FALL QUARTER	WINTER QUARTER	SPRING QUARTER
<b>Year 1</b>		
Math 20A	Math 20B	Math 20C
Chem 6A	Phys 2A	Phys 2B
GE (College Requirement)	Chem 6B	Chem 6C
GE	GE	GE
<b>Year 2</b>		
Math 20D	Math 18	Math 20E
Phys 2C (+ Phys 2CL <sup>1</sup> )	MAE 8 - Intro to MATLAB	MAE 30B – Dynamics and Vibrations
ESYS 101 – Environmental Biology	MAE 30A - Kinematics	MAE 108 - Statistics
MAE 3 - Graphics and Design	GE	GE
<b>Year 3</b>		
MAE 105 - Mathematical Physics	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 107 - Computational Methods	MAE 119 - Renewable Energy	MAE 170 - Experimental Technique
CENG 100 – Modeling and Computations	MAE 11 - Thermodynamics	TE - (Technical Elective)
Chem 171- Environmental Chemistry I	GE	GE
<b>Year 4</b>		
MAE 101C- Heat Transfer	MAE 126A- Engineering Lab	MAE 126B - Engineering Lab
MAE 122- Flow and Transport in the Environment	MAE 123- Intro to Transport in Porous Media	TE
TE	TE	GE
GE	GE	GE

<sup>1</sup>Phys 2CL is not required for the major but it is a prerequisite for MAE 170 so students are highly encouraged to take the course.

**WHEN SCHEDULING CLASSES, THE MAE DEPARTMENT FOLLOWS THIS CURRICULUM GRID. IF YOU CHOOSE TO DEVIATE FROM IT, YOU WILL EXTEND YOUR TIME TO GRADUATION.**

## TRANSFER THREE YEAR PLAN

ENVIRONMENTAL ENGINEERING		
FALL	WINTER	SPRING
<b>Year 1</b>		
ESYS 101 - Environmental Bio	Math 20E	MAE 108 - Statistics
MAE 8 - Intro. to Matlab	MAE 30A- Kinematics	MAE 30B - Dynamics and Vibrations
MAE 3 -Graphics and Design	GE – (College Requirement)	GE
	GE	GE
<b>Year 2</b>		
CHEM 171- Environ. Chemistry	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 105 - Mathematical Physics	MAE 119 - Renewable Energy	MAE 170 - Experimental Technique
MAE 107 - Computational Methods	MAE 11 - Thermodynamics	TE – (Technical Elective)
CENG 100 - Material and Energy Balances	GE	GE
<b>Year 3</b>		
MAE 101C - Heat Transfer	MAE 123 – Intro to Transport in Porous Media	MAE 126B - Engineering Lab
MAE 122 - Flow and Transport in the Environment	MAE 126A - Engineering Lab	TE
TE	TE	GE
GE	GE	GE

**This academic plan assumes that you have completed all of the following courses at your previous college:**

Calculus I for Science and Engineering (MATH 20A), Calculus II for Science and Engineering (MATH 20B), Calculus and Analytic Geometry (MATH 20C), Differential Equations (MATH 20D), Linear Algebra [MATH 18], Complete calculus-based physics series (PHYS 2A, B, C), and general chemistry (CHEM 6A, B & C).

### ENVIRONMENTAL ENGINEERING

In fulfilling the General Education (GE) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Ten GE courses are listed here; individual college requirements may be higher or lower.

Four Technical Elective (TE) courses are required to receive a degree in Environmental Engineering: at least 1 must be an upper division course selected from Scrips Institute of Oceanography (SIO). See the MAE website for a complete list of pre-approved Technical Electives.

# **MECHANICAL ENGINEERING**

The Mechanical Engineering Program has a traditional ABET accredited four-year curriculum involving mechanics, vibrations, thermodynamics, fluid flow, heat transfer, materials, control theory and mechanical design. Graduates of this program find employment in the high-technology elector-mechanical industry as well as in the mechanical and aerospace industry.

***This four-year plan is tentative and should be used as a guide.***  
***Please refer to the MAE website for the most updated curriculum plan.***

## **FRESHMEN FOUR YEAR PLAN**

FALL QUARTER	WINTER QUARTER	SPRING QUARTER
<b>Year 1</b>		
Math 20A	Math 20B	Math 20C
Chem. 6A	Phys 2A	Phys 2B
GE (College Requirement)	GE	MAE 3- Graphics and Design
GE	GE	GE
<b>Year 2</b>		
Math 20D	Math 18	Math 20E
Phys. 2C	MAE 30A - Kinematics	MAE 131A- Solid Mechanics
MAE 20- Materials Science	MAE 8- Intro to MATLAB	MAE 30B- Dynamics and Vibrations
GE	GE	TE – (Technical Elective)
<b>Year 3</b>		
MAE 105 - Mathematical Physics	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 11 - Thermodynamics	MAE 143A - Signals and Systems	MAE 143B - Linear Control
MAE 40 - Linear Circuits	MAE 160 or MAE 131B	MAE 170 - Experimental Technique
MAE 107 - Computational Methods	TE	GE
<b>Year 4</b>		
MAE 101C - Heat Transfer	MAE 156A - Design Lab I	MAE 156B - Design Lab II
MAE 150 - Computer-Aided Design	MAE 171A - Engineering Lab I	TE
TE	TE	GE
GE	GE	GE

**WHEN SCHEDULING CLASSES, THE MAE DEPARTMENT FOLLOWS THIS CURRICULUM GRID. IF YOU CHOOSE TO DEVIATE FROM IT, YOU WILL EXTEND YOUR TIME TO GRADUATION.**

## TRANSFER THREE YEAR PLAN

MECHANICAL ENGINEERING		
FALL	WINTER	SPRING
<b>Year 1</b>		
MAE 3 - Graphics and Design	Math 20E	MAE 131A - Solid Mechanics
MAE 8 - Intro. To MatLab	MAE 30A - Kinematics	MAE 30B - Dynamics and Vibrations
MAE 20 - Materials Science	GE - (College Requirement)	TE - (Technical Elective)
	GE	GE
<b>Year 2</b>		
MAE 105 - Mathematical Physics	MAE 101A - Intro to Fluids	MAE 101B - Advanced Fluids
MAE 11 - Thermodynamics	MAE 143A - Signals and Systems	MAE 143B - Linear Control
MAE 40 - Linear Circuits	MAE 160 or MAE 131B	MAE 170 - Experimental Technique
MAE 107 - Computational Methods	TE	GE
<b>Year 3</b>		
MAE 101C - Heat Transfer	MAE 156A - Design Lab I	MAE 156B - Design Lab II
MAE 150 - Computer-Aided Design	MAE 171A - Engineering Lab I	TE
TE	TE	GE
GE	GE	GE

**This academic plan assumes that you have completed all of the following courses at your previous college:**

Calculus I for Science and Engineering (MATH 20A), Calculus II for Science and Engineering (MATH 20B), Calculus and Analytic Geometry (MATH 20C), Differential Equations (MATH 20D), Linear Algebra [MATH 18], Complete calculus-based physics series (PHYS 2A, B, C), and general chemistry (CHEM 6A).

### MECHANICAL ENGINEERING

In fulfilling the General Education (GE) requirements, students must take at least 24 units in the arts, humanities, and social sciences, not including subjects such as accounting, industrial management, finance, or personnel administration. Eight GE courses are listed here; individual college requirements may be higher or lower.

Technical Elective (TE) courses must be upper-division or graduate courses in the engineering sciences, natural sciences or mathematics and must be selected with prior approval of the Department. See the MAE website for a complete list of pre-approved Technical Electives.

### Mechanical Engineering Specializations

Students will have the option to take four out of five technical electives from a list of preapproved technical electives in a selected specialization in a particular topic. This optional specialization will show on the student's transcript and final degree. The specializations are:

- Controls and Robotics
- Fluid Mechanics and Thermal Systems
- Mechanics of Materials
- Materials Science and Engineering
- Renewable Energy and Environmental Flows (REEF)

# ACADEMIC ENRICHMENT

## Cooperative Education (Co-op)

The Cooperative Education (Co-op) Program is an immersive work experience in which students are employed full-time by a company for up to six months, which includes summer and one academic quarter, to supplement education with real-world experiences. Students with a minimum junior standing and a 3.0 GPA are eligible to apply. Positions are not guaranteed and students must apply and interview such as in any internship/job opportunity. For more information, please see academic advisors.

## Academic Internships: Special Study (MAE 197)

The UCSD Academic Internship Program coordinates work experiences for undergraduates with industry, government offices, and hospitals. Students work under the supervision of either a faculty member or an industrial supervisor. The position may or may not be salaried. Students may receive up to 12 units of academic credit by registering for MAE 197 Engineering Internship and completing a research paper or technical laboratory report on their internship work. The typical student time commitment to the internship is ten hours per week for every four units of academic credit. However, students may not receive upper division technical elective credit for such internships.

## Undergraduate Research and Independent Study (MAE 199)

Undergraduates may participate in engineering research at UCSD through a number of informal and formal mechanisms. Many students first become familiar with research by participating 5-10 hours per week during the academic year or 10-20 hours per week in the summer on a volunteer basis.

**Independent Study for Undergraduates (MAE 199)** courses offer qualified and motivated students the opportunity to work closely with faculty and graduate students and gain firsthand experience in conducting research. MAE students may take MAE 199 under the guidance of an MAE faculty member. This course is taken as an elective on a P/NP basis. Under the following restrictive conditions, however, it may be used to satisfy upper-division technical elective course requirements for the major:

- The student must be in the major and have a GPA or **3.0** or better at the beginning of the MAE 199 project.
- The project must cover **two consecutive quarters** of work and the performance must be equivalent to A or B work, as determined by the 199 project advisor and the Undergraduate Affairs Committee. If the performance is not of A or B quality after the first quarter, the advisor can cancel the "contract" and the student may not attempt additional MAE 199 units.
- The student must declare his intention to seek technical elective credit by filing out a Special Studies Form (each quarter) and an MAE 199 Contract (first quarter). These forms must be completed, approved, and processed by the beginning of the quarter in which the course is to be taken. Students cannot enroll in MAE 199 without first meeting with your 199 professor and submitting the Special Studies request via the online EASy portal.

The student, the MAE advisor, and the department chairperson must sign the contract. At the end of the first quarter, a progress report must be submitted to the advisor. The advisor may cancel the contract for less than B performance, assigning a grade of P or NP, as appropriate. These units will not count toward technical elective credit. At the end of the second quarter, the advisor will assign an internal letter grade based on the final written report and discussions with the student during the previous quarter. If the grade is less than a B, a grade of P or NP will be reported for the second quarter and no technical elective credit will be given. Otherwise, the final report must be submitted to the Undergraduate Affairs Committee by the student's 199 advisor at the end of the second quarter to determine if the student will receive technical elective credit. It is the students' responsibility to make sure that his/her 199 advisor gets the report turned in on time to the Undergraduate Affairs Committee.

## **Opportunities Abroad**

Engineering is a global field offering jobs throughout the world. You can prepare yourself for these opportunities with an exciting study or internship experience abroad. Through the Programs Abroad Office, students may receive credit for international study through a variety of programs. For information on these programs, first contact the [Programs Abroad Office](#) (858-534-1123) or visit the International Center on Library Walk.

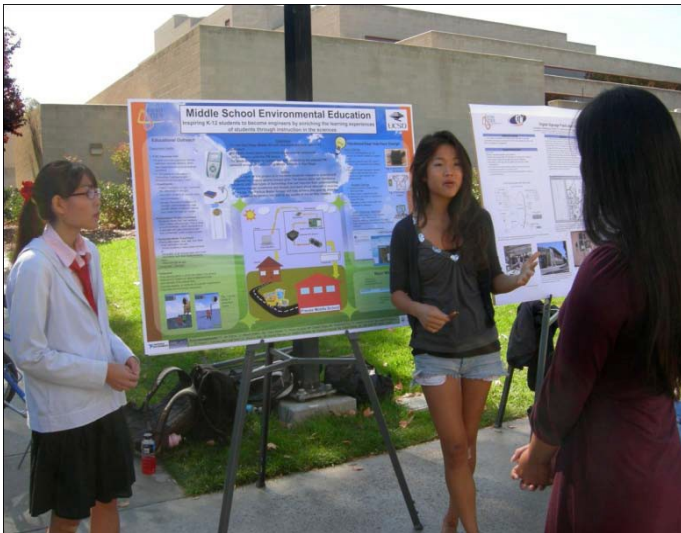
**[Global Teams In Engineering Service \(TIES\)](#) – For more information, contact Mandy Bratton**

**Phone: (858) 822-4164, email: [mbratton@ucsd.edu](mailto:mbratton@ucsd.edu)**

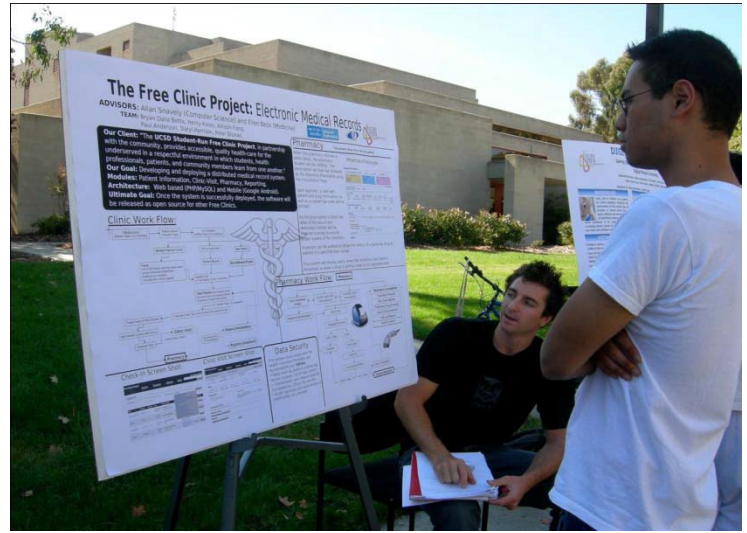
Teams in Engineering Service are an innovative service-learning academic program putting UCSD undergraduates and their technical and creative skills to work for San Diego non-profit organizations. Multi-disciplinary teams of UCSD students design, build, and deploy projects that solve technology-based problems for community partners.

TIES projects can range from working with orthopedists and physical therapists to developing and building mechanical tools or prosthetics for the developmentally disabled and to working with agriculture to develop new irrigation solutions for local farming communities.

The benefits for student's involvement in TIES are numerous, and include improved communication, organizational, and leadership skills, start-to-finish design experience, multi-disciplinary teamwork, experience in project and resource management, ethics training and responsibility, as well as customer and community awareness. Finally, TIES provides demonstrable and measurable outcomes of undergraduate engineering theoretical knowledge, technical skills, teamwork, communication, ethical responsibility and value for professional development. Mechanical, Engineering Science, and Environmental majors students are eligible to receive 4 units of technical elective. \*Note: The Aerospace major does not currently offer technical elective credit for either ENG100 or ENG100L. For more information about TIES as a technical elective, please see an MAE Undergraduate Advisor.



TIES Project - Middle School Environmental Education



TIES Project- The Free Clinic Project: Electronic Medical Records



**Team Internship Program (TIP) - For more information contact Loren Metzger**

**Phone: (858) 822-6772, email: [lemetzger@ucsd.edu](mailto:lemetzger@ucsd.edu)**

Today's employers are looking for engineers who have both technical skills and the ability to collaborate and function as a team. Summer Team Internships are part of the Jacobs School of Engineering's effort to enhance our students' education through real-world engineering experiences in a team setting. Students work on-site with local, domestic, and international industry partners as a multi-disciplinary team of 2-5 students, focused on a clearly defined and significant project. TIP is a 10-12 week, full time, paid internship program during the summer.

Undergraduate and graduate students of all levels in all engineering departments are eligible to apply. All application and resumes are screened by the TIP Office and candidates who best meet the criteria are forwarded to companies for review.

TIP also offers resume guidance and professional development training to all applicants. This is designed to help students make the best impression at their interviews. TIP, in collaboration with the Corporate Affiliates Program (CAP), works with some of the top engineering companies. Many TIP students are offered full time employment upon finishing their internship.

**Participating Companies**



**IDEA CENTER**

The Jacobs School of Engineering supports several programs that promote academic and professional development for undergraduate students across all engineering departments. These include:

- **Engineering Student Organizations**
- **Jacobs Undergraduate Mentoring Program (JUMP)**
- **Success Workshops for Emerging Engineers in Training (SWEET)**
- **Internship Programs**
- **Tutoring**

Students are encouraged to contact these programs through email ([idea@soe.ucsd.edu](mailto:idea@soe.ucsd.edu)), by phone (858) 534-6105, or personally at Room 1400, Jacobs Hall.

## **Student Societies and Organizations**

The Undergraduate Student Advisory Committee (USAC) is a group of undergraduate students consisting of representatives from the MAE Department. The representatives are selected/appointed by the students each year. The group meets with the Undergraduate Affairs Committee (UAC) Chair on a semi-annual basis. The group discusses all aspects of student life with a focus on the undergraduate programs in MAE. The concerns and suggestions communicated by USAC are presented to the faculty and administration for consideration. USAC also provides a link to the student professional and honor societies that are active in the Jacobs School of Engineering (JSOE). These societies include AIAA, ASME, AIChE, SAE, SWE, and Tau Beta Pi. For more information, please contact [mae-usac@eng.ucsd.edu](mailto:mae-usac@eng.ucsd.edu)

The [Center for Student Involvement](#) coordinates the formation of student clubs that are run by and for students. All of these groups are represented at the Fall Festival on the Green (FFOG), usually held in mid-October. Call (858) 534-0501 or email [getinvolved@ucsd.edu](mailto:getinvolved@ucsd.edu) for further information.

MAE undergraduate students participate in student chapters of the American Institute of Aeronautics and Astronautics (AIAA), American Society of Civil Engineers (ASCE), and American Society of Mechanical Engineers (ASME). These student chapters invite external speakers, organize trips to local companies, visit local projects and participate in regional and national design competitions.

A number of other engineering societies are active at UCSD. The Society of Women Engineers (SWE) encourages and supports women in engineering. They sponsor talks, provide workshops, and distribute information about opportunities for women in engineering. The Society of Hispanic Professional Engineers (SHPE) promotes the development of Hispanics in engineering, science, and math to achieve educational excellence, economic opportunity, and social equity. The National Society of Black Engineers (NSBE) provides a forum of support for African-American engineers. Each year, NSBE, SWE, and SHPE sponsor a Night of Industry, designed to inform undergraduate minority engineers of industrial opportunities. Tau Beta Pi (TBP) at UCSD is a member of the National TBP engineering honor society. Engineering students who rank in the top 1/8 of juniors and the top 1/5 of seniors are contacted by TBP for possible membership. These students are eligible for membership in TBP if they complete an interview process as well as a community service project. Throughout the year, TBP invites speakers to club meetings, organizes tours of companies, and provides a tutoring service.

## **Engineering Student Employment Opportunities**

In a coordinated effort, the IDEA Center assists Career Services, the Academic Internship Program, interested companies, and faculty and staff in disseminating information about job opportunities for engineering students. These opportunities include permanent employment, part-time employment during the academic year, summer employment and contract work. If you have additional questions about this service, you may contact the coordinator at [idea@soe.ucsd.edu](mailto:idea@soe.ucsd.edu) or by phone at (858) 534-6105.

## **Getting Experience**

The Jacobs School of Engineering is located at the heart of San Diego's thriving technology and life sciences industry, and career opportunities abound for our students. Engineering students make connections with prospective employers through the following resources:

**CAP Resume Database:** Students gain an insider advantage by posting their resumes to the CAP (Corporate Affiliates Program) Resume Database. Our 50+ industry partners can access student resumes online via this members-only searchable database.

**Career Center:** The Center is a one-stop shop for career exploration, resume development, grad school preparation, career fairs, and Port Triton job postings. Students seeking internships or full-time jobs can sign up for interviews on campus with selected employers.

**Student Organization Career Networking:** Our student organizations invite companies to campus for recruitment and networking activities geared towards specific engineering disciplines. The Triton Engineering Student Council's (TESC) annual Disciplines of Engineering Career Fair (DECaF) draws more than 70 companies and 1,500 attendees.

**Global TIES:** Engineering students can build their resume and develop their technical, leadership, project management, and communication skills via our signature community and corporate team engineering programs. Students can get technical elective credit and experience via the TIES service-learning program or can apply to be selected for a paid, full-time Team Internship during the summer.

**Academic Internship Program (AIP):** Students can earn academic credit for internships through the UCSD AIP program. Internships are available locally, nationally, and via specific programs in New York City (NY), Washington (D.C.), Sacramento (CA), London (England), and Sydney (Australia).

## **IDEA Study Lab**

Tau Beta Pi and Eta Kappa Nu, Engineering Honor Societies, offer FREE tutoring sessions at the IDEA Study Lab for undergraduate engineering students. The IDEA Study Lab is located at Jacobs Hall 4600. Check their online calendar for the weekly tutoring schedule. Fill out the tutoring form if you'd like to request a specific class or time. Please note that individual tutoring is done on a first-come, first-served basis.

## **ACADEMIC SUPPORT**

### **[OASIS \(Office of Academic Support and Instructional Services\)](#)**

The Office of Academic Support and Instructional Services (OASIS) provides a variety of services to maximize student performance and retention at UC San Diego. OASIS provides free activities that support and contribute to the improvement of teaching and learning. Programs range from services to help students overcome past academic inefficiencies to programs that help them excel in a subject matter or skill. All students in any of the six colleges are eligible for OASIS programs. Classes are non-credit and may be repeated. Course titles and schedules can be found on the OASIS website. Professional and peer counselors assist in all areas with adjustment to university life. In addition, there are tutors in writing, study skills, lower-division math, physics, chemistry, economics, biology, and computer science.

### **Tutorial Program**

OASIS provides free tutoring in lower-division biology, chemistry, physics, mathematics, economics, and computer science. Tutors are available on a drop-in basis to help the student become an independent learner. Tutors often arrange to hold group sessions in various locations throughout campus. For more information: Center Hall, 3rd Floor, Tel. 534-3760.

## **OPPORTUNITIES FOR UNDERREPRESENTED STUDENTS**

The [Academic Enrichment Programs \(AEP\)](#) office manages several programs to help underrepresented undergraduate students prepare for graduate school and careers in research and college teaching. These activities complement the OASIS Academic Transition Program and Student Support Services in the Jacobs School of Engineering.

The [McNair Program](#) serves low-income, first-generation college students and under-represented minorities who are interested in pursuing a Ph.D. It is a one-year rigorous program of scholarly activities that includes participation in the Faculty Mentor Program and the Summer Research Program. In addition, participants receive training in how to write and present a scholarly paper, preparation for the GRE, and assistance with the graduate school application process. All participants have the opportunity to present a paper at a minimum of two research conferences.

The [Summer Research Program \(SRP\)](#) offers full-time research experience to underrepresented students (i.e., minorities, women, and low-income, first generation college students) who are interested in preparing for careers in research or university teaching. As research assistants, students work on their faculty mentor's project for at least 30 hours per week. Students are trained in research skills, how to write and present a research proposal or paper, and how to prepare for the GRE. At the conclusion of the program, students present their papers at the UCSD Summer Research Conference. Students who participate in this intensive 8-week program may receive free on-campus housing, 4 units of MAE 199 (Independent Study) credit, and stipends. Eligible students are juniors and seniors who have a 3.0 GPA or above and plan to attend graduate school.

The [Undergraduate Research Conference \(URC\)](#) is an annual event where more than 100 students who have written outstanding research papers are invited to present their research. Invitation is by faculty nomination. Students present their papers at small round table discussions led by a faculty. Conference participants receive a certificate as a research scholar.

The [Faculty Mentor Program \(FMP\)](#) offers invaluable research experience to all junior or seniors with a GPA of 2.7 or higher who have the desire to prepare for graduate or professional school. This program is an excellent way to get to know and work with a UC San Diego faculty mentor for two quarters. It is great preparation for graduate and professional school. All students who complete the FMP application and meet the eligibility requirements may participate if a suitable research placement can be arranged.

## **ETHICAL STANDARDS OF THE ENGINEERING STUDENT**

**The UCSD Policy on Integrity of Scholarship states the general rules for student integrity.**

### **Instructor's Responsibility**

At the beginning of the term the instructor shall state in writing (e.g., in the syllabus, information sheets, or website) what graded assignments and exams will be required of students. If there are any course-specific rules required by the instructor for maintaining academic integrity, the instructor shall also inform students in writing what kinds of aid and collaboration, if any, are permitted on graded assignments and exams.

### **Student's Responsibility**

Students are expected to complete the course in compliance with the instructor's standards.

No student shall engage in an activity that involves attempting to receive a grade by means other than honest effort; for example:

- No student shall knowingly procure, provide, or accept any unauthorized material that contains questions or answers to any examination or assignment to be given at a subsequent time. **THIS INCLUDES SOLUTIONS MANUALS.**
- No student shall complete, in part or in total, any examination or assignment for another person.
- No student shall knowingly allow any examination or assignment to be completed, in part or in whole, for himself or herself by another person.
- No student shall plagiarize or copy the work of another person and submit it as his or her own work.
- No student shall employ aids excluded by the instructor in undertaking course work or in completing any exam or assignment. **THIS INCLUDES SOLUTIONS MANUALS.**
- No student shall alter graded class assignments or examinations and then resubmit them for re-grading.
- No student shall submit substantially the same material in more than one course without prior authorization.

Students are expected to notify their instructor or appropriate officials, such as their college Dean, about any incident of dishonesty they observed.

## **JACOBS SCHOOL STUDENT HONOR CODE**

We, the members of the Jacobs School of Engineering, have a responsibility as students, faculty and staff to ensure the highest level of integrity in our academic and social practices.

As Jacobs School engineering students, we are creating the foundation for our futures as engineers. We must look to pursue knowledge justly, fairly, and honestly. The value of our education is in understanding that learning is a lifelong commitment. The experiences that we share and the skills that we learn are all the more valuable if we hold ourselves to high ethical and moral standards.

The Jacobs School must promote leadership, honesty and integrity. The Jacobs School community must work together to ensure that these qualities are valued. We must also make a conscious effort to provide our students with the instruction that will prepare them for a professional career. Instructors will honor their teaching responsibilities, and in turn students will reflect this commitment by pursuing leadership, honesty and integrity in their own academic endeavors.

This is a personal and professional commitment that we all share as members of the Jacobs School of Engineering. We pledge ourselves to these ideals and promise to be honest in our hearts, minds and our actions.

- Triton Engineering Student Council, 2003

## **PROFESSIONAL ENGINEERING (PE) LICENSE**

Whether you design power plants, consumer goods, buildings, or aerospace vehicles, whether you work in private industry, for the U.S. government, or for the public and whether your efforts are theoretical or practical, you (as an engineer) have a significant responsibility.

Engineers of all types perform exciting and rewarding work, often stretching new technologies to their limits. But those limits are often incomprehensible to non-engineers. As the ambient level of technological sophistication increases, the public depends increasingly and unhesitatingly on engineers. That is where professional licensing and the National Society of Professional Engineers (NSPE) become important.

NSPE, the leading organization for licensed engineering professionals, is dedicated to serving the engineering profession by supporting such activities as continuing educational programs for its members, lobbying and legislative efforts on local and national levels and promoting guidelines for ethical service. From local, community-based projects that encourage top-scoring high school students to choose engineering as a career, to hard-hitting lobbying efforts in the nation's capital to satisfy the needs of all engineers, NSPE is committed to you and your profession.

Engineering licensing is a two-way street: it benefits you while it benefits the public and the profession. For you, licensing offers a variety of advantages, ranging from peer recognition to greater advancement and career opportunities. If you wish to become an *independent engineering consultant*, it is required by law that you are registered. Some states require registration as a Professional Engineer if you wish to use the title engineer. A court of law generally will not recognize an individual as an engineer unless he/she is registered, thus one cannot testify as an expert witness or try to collect engineering fees unless one is registered. For the profession, licensing establishes a common credential by which engineers can be compared. For the public, a professional engineering license is an assurance of a recognizable standard of competence.

The requirements for professional engineering registration prevailing in most of the states are as follows:

- 1) Graduation from an ABET accredited school, plus four years of engineering experience acceptable to the board, plus passage of a 16-hour written examination, or
- 2) Eight years of engineering experience acceptable to the board, plus passage of a 16-hour written examination.

The 16-hour written examination is divided into two equal parts: the first is generally known as the "Fundamental Examination" (sometimes referred to as the "Engineering-in-Training" exam or the EIT) and the second, as the "Professional Examination," (sometimes referred to as the PE exam or the "Principles and Practices" exam). Persons who successfully pass these examinations are entitled to use the title "Professional Engineer" and to place the initials "P.E." after their names. It is illegal for unregistered persons to use the title.

Nearly all states have made provisions for an EIT status and will allow persons to take the first eight-hour (EIT or "Fundamentals") portion of the written examination immediately before or immediately after graduation from an ABET accredited school. EIT status conveys no legal privileges and is offered primarily as a convenience to new graduates so that they can take the examination in fundamentals at a time when the material is still fresh in their minds. Almost all of the states use a uniform national EIT examination, administered through the National Council Engineering Examiners (NCEE) and a great majority uses a uniform national examination for the "Professional" portion.

The 8-hour EIT exam, which is generally offered twice a year (April, October), is a closed-book exam (calculators allowed) that consists of two four-hour sessions separated by a one-hour lunch. The morning session has 140 multiple choice questions covering such topics as: chemistry, electric circuits, mathematics, statistics, dynamics, mechanics, material science, thermodynamics, engineering economics, fluid mechanics. Since all 140 morning problems must be worked to get full credit, it is important that you know all subject areas and have strategy that involves fast recall (memorize formulas, solution procedures, important data) and stamina. The afternoon session consists of 70 questions in 5 topics engineering mechanics, applied mathematics, electrical circuits, and engineering economics and thermo/fluid mechanics. No material of any kind will be allowed. A reference handbook will be furnished at the exam site and will be collected at the conclusion of the examination.

For application and further information regarding the California EIT and PE examinations contact:

State Board of Registration for Professional Engineers and Land Surveyors  
2535 Capitol Oaks Drive, Suite 300  
Sacramento, California 95833-2944

or call (866) 780-5370, or visit their website: <https://www.bpelsg.ca.gov/>

For more information regarding Professional Engineering membership, call (703) 684-2800, or visit their website: <https://www.nspe.org/>

## **Degrees Required**

A bachelor's degree in engineering is generally required for entry-level engineering jobs. Engineering degrees from one area may be able to work in related areas. For example, many aerospace engineers have training in mechanical engineering. This flexibility allows engineers to shift in fields. Graduate training is essential for engineering faculty positions but is not required for the majority of entry-level engineering jobs. Many engineers obtain graduate degrees to learn new technology, broaden their education, and enhance their promotional opportunities. It is important for engineers to continue their education throughout their careers because much of their value to their employer relies on their knowledge of current technologies.

*Source: Bureau of Labor Statistics*

## **Preparation for Graduate Studies**

Many engineers, after receiving their Bachelor's degrees choose to continue their education and training by enrolling in graduate programs leading to the Master of Science (M.S.) or Doctor of Philosophy (Ph.D.) degrees in Engineering. A Ph.D. degree is required for research and teaching at the college and university level.

General information on graduate schools can be obtained from the MAE graduate advisor and through the Professional and Graduate School Advising Office of the Career Services Center ([career.ucsd.edu](http://career.ucsd.edu)). The Career Center has the current edition of *Peterson's Guide to Graduate Schools*, which contains information on Graduate Engineering Programs. Also, the Career Center has information on the Graduate Record Examinations (GRE), typically taken in spring of junior year or fall of senior year. In addition, the Career Center coordinates the distribution of letters of recommendation to graduate schools.

Admission to graduate schools of engineering is typically based on undergraduate GPA (a minimum of 3.0 is typically required), GRE scores, letters of recommendation from faculty, reputation of undergraduate institution and additional research or professional activities of the applicant. Applications are typically due at the end of December or the beginning of January for admission to the fall quarter or semester.

The most common form of financial aid for academic doctoral study is a departmental assistantship (teaching or research), in addition to some form of tuition remission or waiver (partial or full) by the institution or department. Most research university doctoral programs attempt to fund students throughout their Ph.D. programs. External fellowships (e.g., NSF Fellowship, Ford Foundation Fellowship) or other competitive awards sometimes augment institutional aid. Funding for academic masters programs generally varies from none to partial to full funding; however, many masters students must fund all or part of their graduate education.



# MAE FACULTY

<b>Name</b>	<b>Phone ( 858)</b>	<b>Email: @ucsd.edu</b>	<b>Research Area/s</b>
<b>Anderson, Mark</b>	822-7939	m3anderson	<b>Design/Engineering Education/Aerospace</b>
<b>Arefiev, Alexey</b>		aarefiev	<b>Plasma &amp; Fusion</b>
<b>Bandaru, Prabhakar</b>	534-5325	pbandaru or prab	<b>Energy / Solid Mechanics and Materials Science</b>
<b>Becker, Janet</b>		jmbecker	
<b>Beg, Farhat</b>	822-1266	fbeg	<b>Energy</b>
<b>Bewley, Tom</b>	534-4287	tbewley	<b>Design/ Dynamic Systems &amp; Control</b>
<b>Bitmead, Robert</b>	822-3477	rbitmead	<b>Dynamic Systems &amp; Control</b>
<b>Boechler, Nicholas</b>	534-2563	nboechler	
<b>Cai, Shengqiang</b>	534-2372	shqcai	<b>Solid Mechanics and Materials Science</b>
<b>Cattolica, Robert</b>	534-2433	rcattolica	<b>Energy</b>
<b>Chen, Renkun</b>	534-2433	rkchen	<b>Energy/ Environmental Engineering</b>
<b>Coimbra, Carlos</b>	534-4285	ccoimbra	<b>Energy / Environmental Engineering</b>
<b>Cortes, Jorge</b>	822-7930	cortes	<b>Dynamic Systems &amp; Control</b>
<b>del Alamo, Juan Carlos</b>	534-5962	jalamo	<b>Biomechanics/ Fluid Mechanics, Combustion and Engineering Physics</b>
<b>de Callafon, Raymond</b>	534-3166	callafon	<b>Design/Dynamic Systems &amp; Control</b>
<b>Delson, Nate</b>	534-0655	ndelson	<b>Design/Engineering Education/Robotics/Mechanical Devices</b>
<b>Frazier, Michael</b>		mjfrazier	<b>Mechanics &amp; Materials</b>
<b>Friend, James</b>	534-5019	friend	<b>Design, Fluid Mechanics/Heat Transfer, Mechanics and Materials, Medical Devices</b>
<b>Garay, Javier</b>	534-4903	jegaray	<b>Mechanics &amp; Materials</b>
<b>Ghazinejad, Maziar</b>	534-5832	mghazinejad	
<b>Gibson, Carl</b>	534-3184	cgibson	<b>Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Graeve, Olivia</b>	246-0146	ograeve	<b>Solid Mechanics and Materials Science</b>
<b>Gravish, Nicholas</b>		ngravish	<b>Robotics and Design</b>
<b>Herbert, Sylvia</b>			
<b>Hidalgo-Gonzalez, Patricia</b>		phidalgogonzalez	
<b>Hwang, John</b>	246-3070	jhwang	
<b>Kamensky, David</b>		dmkamensky	<b>Mechanics &amp; Materials</b>
<b>Kleissl, Jan</b>	534-8087	jkleissl	<b>Energy/ Environmental Engineering/ Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Kosmatka, John</b>	534-1779	jkosmatka	<b>Solid Mechanics and Materials Science</b>
<b>Kramer, Boris</b>	246-5327	bmkramer	<b>Fluid Mechanics</b>
<b>Krashennnikov, Sergei</b>	822-3476	skrashen	<b>Energy</b>
<b>Krstic, Miroslav</b>	822-1374	mkrstic	<b>Dynamic Systems &amp; Control</b>

<b>Name</b>	<b>Phone ( 858)</b>	<b>Email: @ucsd.edu</b>	<b>Research Area/s</b>
<b>Lal, Ratnesh</b>	822-0384	rlal	
<b>Lasheras, Juan C.</b>	534-5437	jlashera	<b>Biomechanics/Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Lindsey, Stephanie</b>			
<b>Llewellyn Smith, Stefan</b>	822-3475	sgls	<b>Environmental Engineering/ Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Lubarba, Marko</b>		mlubarda	
<b>Lucas, Andrew</b>	822-2580	ajlucas	
<b>Martinez, Sonia</b>	822-4243	soniamd	<b>Dynamic Systems &amp; Control</b>
<b>McEneaney, William</b>	822-5835	wmceneaney	<b>Dynamic Systems &amp; Control</b>
<b>Meyers, Marc</b>	534-4719	mameyers	<b>Solid Mechanics and Materials Science</b>
<b>Miller, David</b>	534-3182	dmiller	<b>Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Morimoto, Tania</b>	534-1375	tamorimoto	
<b>Nemat-Nasser, Sia</b>	534-4914	sia	<b>Solid Mechanics and Materials Science</b>
<b>Nesterenko, Vitali</b>	822-0289	vnesterenko	<b>Solid Mechanics and Materials Science</b>
<b>Nomura, Keiko</b>	534-5520	knomura	<b>Environmental Engineering/ Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Pawlak, Geno</b>	534-2343	epawlak	<b>Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Peterson, Lonnie</b>			
<b>Pisano, Al</b>	534-6237	appisano	<b>Design, Mechanics and Materials</b>
<b>Poulikakos, Lisa</b>			
<b>Qi, Huihui</b>		huqi	
<b>Rangamani, Padmini</b>	534-4734	padmini.rangamani	<b>Biomechanics, Biomaterial, Medical Devices</b>
<b>Rosengren, Aaron</b>		arosengren	
<b>Saha, Abhishek</b>		asaha	
<b>Saintillan, David</b>	534-2415	dsaintillan	<b>Fluid Mechanics and Heat Transfer/ Biomechanics</b>
<b>Sanchez, Antonio</b>	822-3790	alsp	<b>Fluid Mechanics and Heat Transfer/ Combustion</b>
<b>Sarkar, Sutanu</b>	564-8243	ssarkar	<b>Fluid Mechanics, Combustion and Engineering Physics</b>
<b>Seshadri, Kalyanasundaram</b>	534-4876	kseshadri	<b>Energy</b>
<b>Schmidt, Oliver</b>	246-5818	oschmidt	<b>Fluid Mechanics</b>
<b>Talke, Frank</b>	534-3646	ftalke	<b>Design</b>
<b>Tartakovsky, Daniel</b>	534-1375	dmt	<b>Environmental Engineering/ Fluid Mechanics, Combustion and Engineering Physics</b>

# MAE FACULTY

Name	Phone ( 858)	Email: @ucsd.edu	Research Area/s
<b>Tolley, Michael</b>	534-1355	tolley	<b>Dynamic Systems and Control, Design,</b>
<b>Tynan, George</b>	534-9724	gtynan	<b>Energy</b>

# MAE FAQ

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## Advising

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### **Q) What is the difference between college and department advising?**

A) Each undergraduate student at UC San Diego has advisors in their academic department as well as in their college. MAE advisors are department specialists rather than generalists.

### **MAE Academic Advising**

The MAE advisors help students with major curriculum planning, petitions for MAE coursework, department regulations, degree checks, etc. Department advisors can also refer students to faculty for advice on engineering specializations, technical electives and career options.

### **College Advising**

College advisors assist students in understanding their GE and University graduation requirements. They can help students understand policy and procedures, develop personalized educational strategies, and serve as specialists in the college-specific general education requirements.

### **Q) How do I make an appointment to meet with an MAE Academic Advisor?**

A) We have walk-in advising and appointment advising. Please check the MAE website [here](#) for exact hours.

### **Q) What are the GE courses on my three/four-year plan?**

A) The GE courses listed on your major curriculum are simply there to help you plan your college general education courses accordingly. Please see your college advisor for more information regarding your required GE courses.

### **Q) Can I switch from my current college to another college?**

A) Yes, but only after you have completed your college's writing program and if you can demonstrate that switching to a different college will allow you to graduate in fewer academic quarters. In practice, the overwhelming majority of students are happy with their college assignment, even if it was not their first choice originally, and few students apply to switch. Please contact your college for more information.

## Academic History

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### **Q) If I received AP credit for a lower-division math or science course required for my major, do I have to retake the course?**

A) No. If you received AP credit for a course, such as Math 20A or Physics 2A, you do not have to take the class again. We advise that you continue with the series as prescribed in your curriculum. Please double check with the respective department and make sure that you know which classes you are exempt from taking. Credit for Math 10A or Physics 1A is not the same as Math 20A or Physics 2A. Credit for Math 10A DOES NOT exempt you from Math 20A.

### **Q) How do I determine if my major department has received my transcripts/AP scores?**

A) Your major department does not handle, receive or evaluate your transcripts. If you have questions about your transcripts or AP scores, please contact the Admissions Office. Otherwise, please keep checking to make

# MAE FAQ

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sure that all courses you have taken at your previous community college/university have transferred in by checking your "Academic History" via [TritonLink](#).

## Q) How will I know which courses have transferred to UCSD?

A) The website [Assist.org](#) is a useful tool for determining transfer course equivalency between UCSD and California community colleges. You can also check which of your transfer courses successfully transferred in by checking your "Academic History" or "Degree Audit" via [TritonLink](#).

## Q) I took a course at my community college/university that is similar to a course at UCSD but it is not articulated on my Academic History. What do I do?

A) Some engineering courses from a community college or other university do not automatically transfer to UCSD. For MAE courses, you will need to petition for equivalency of this course with a particular MAE course. For the MAE Department, a course substitution petition must be submitted through the MAE [Undergraduate Online Petition Portal](#):

- **Check with [Assist.org](#)** to see if a course equivalency already exists between the transfer course and MAE course. If so, then you will not need to petition but instead just let the advisors know.
- **Fill out a "course substitution" petition** using the MAE Online [Undergraduate Petition Portal](#).
- **Attach documentation of transfer course work** to your petition (e.g., detailed syllabus, title of textbook, lecture notes, and exams).
- **Submit** your petition.

Your petition will be reviewed by an MAE faculty member. The faculty might require more information from you about the course (e.g., lecture notes) in order to make a decision. It is not guaranteed that they will be able to judge whether or not a transfer course is equivalent to an MAE course if you are not able to provide sufficient coursework.

You will be notified of the petition decision through the Virtual Advising Center (VAC). If the transfer course is determined to be equivalent, then your Degree Audit will be updated to reflect this. **You might still encounter registration problems** in this situation because the registration system may not recognize the articulation. If your equivalent transfer course is a prerequisite, then you'll need to request clearance from the MAE advisors a few days BEFORE your registration time. **DON'T WAIT UNTIL YOUR REGISTRATION DATE AS YOU MAY END UP ON A WAITLIST!**

## Q) My transfer academic history is incorrect on my Triton Link. Who should I speak to about correcting my academic information?

A) *Sometimes, transferable course numbers are listed incorrectly in the Academic History section in TritonLink.* You will most likely run into this problem if you completed a series, such as the Physics series, at two or more community colleges.

A MAE Advisor can fix only MAE-transferable courses. For math and science course corrections, please see that specific department (e.g., for a Math course see the Math Department). An error like this will keep you from enrolling into other MAE courses.

## Enrollment

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### Q) When can I enroll in classes? How do I enroll in my classes?

A) Your enrollment time and date will be posted on WebReg. If you need help finding your registration time or need help with enrollment, please review the WebReg tutorial at: <http://registrar.ucsd.edu/studentlink/WebRegTriton.pdf>

# MAE FAQ

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## Q) What is two-pass enrollment?

A) The campus has a two-pass enrollment process for all undergraduate students that allows you to “pass” through the enrollment process twice before enrolling in your full course load for any given quarter.

**How the two-pass enrollment system works:** All students are assigned TWO enrollment times and dates appointments. Please check TritonLink for your enrollment times and dates.

### **FIRST PASS (48 hour window):**

- You may ENROLL in up to 11.5 units.
- You will be UNABLE TO WAITLIST in courses during the first pass.
- You will have 48 HOURS to complete your enrollment during the 1st pass.
- Students who do not enroll during their 1st pass appointment must WAIT UNTIL THE 2ND PASS to enroll.

### **SECOND PASS**

- You may ENROLL IN UP TO 19.5 units.
- You may WAITLIST for courses during the 2nd pass.
- Once your 2nd pass enrollment has started you can add classes until Week 2 of the quarter.

## Q) How do I prioritize my enrollment?

A) Many students are unsure about which courses to enroll in during their first pass. The following information is intended to offer some general guidance. During your first enrollment pass, it is recommended you prioritize your enrollment based on the following criteria:

- Courses required for your major.
- Courses that are prerequisites for courses you intend to take in subsequent quarters.
- Infrequently offered courses, such as those offered only once a year or in alternate academic years.
- Small courses with limited seats, such as labs, e.g., MAE 3, MAE 170, etc.

### **How to prepare for your enrollment appointment.**

1. Determine which courses you want to enroll in prior to your enrollment appointment.
2. Check to see that you have satisfied the necessary prerequisites to enroll.
3. Have back-up options in the event the course you want to take is full.
4. Speak with your department and college advisor prior to your enrollment time for further assistance.
5. If you petitioned for transfer equivalency with an MAE course and it is a prerequisite, please come to the MAE Student Affairs Office to be cleared in the registration system a few days BEFORE your registration time. Don't wait until your registration date as you may end up on a waitlist!

## Q) What if the class I want to add is full?

A) If a class you hope to add is full, add yourself to the waitlist during your second-pass enrollment period. Please note that you cannot waitlist for any course during your first pass. If you need to take the course that quarter to graduate on time, you might receive an email from MAE Advising with instructions for overriding the waitlist. If you receive this email, you must drop yourself from the waitlist and add the course again. Other than this, the waitlist sequence is first-come, first-served. Be sure to enroll during your appointment time! An automated computer program will move eligible students off the waitlists and into classes as seats become available. It will run nightly through the end of the second week of the quarter.

Keep in mind that classes fill up fast during the initial registration period. During the first week of the quarter, students will start to drop courses as they readjust their schedules, opening spaces in the courses. Once space is available, students will automatically be enrolled in the course.

# MAE FAQ

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## Q) Are all MAE courses offered every quarter?

A) No. Some courses are offered only once a year. If you miss taking that course in the quarter that it's offered, you will have to wait a year to take it. A complete schedule of courses offered for this year is located both in the MAE lobby and on the MAE website at [mae.ucsd.edu](http://mae.ucsd.edu).

## Q) TritonLink won't let me enroll in a class. It says I don't meet the prerequisites. What do I do?

A) If you do have the prerequisites, please submit an [Enrollment Authorization System \(EASy\)](#) request so that the MAE department can check into this. However, if you do not have the prerequisites, the MAE Department has a very strict prerequisite policy. A 3.0 GPA minimum will be required for all petitions requesting to enroll in a course without successfully completing its prerequisite/s. If you are trying to add a course in a different department, please see that specific department. (E.g., For a course in Computer Science and Engineering please contact the CSE Department).

## Capped Major

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### Q) What if I want to switch majors?

A) If your desired major is not capped, you can switch to that major on your student portal on TritonLink. **If you plan to switch to a capped major, please contact that department for more information.** Once you change your major you must wait 3 weeks before you can change your major again. It is advised to contact the department you wish to switch to prior to switching.

### Q) What is a Capped Major?

A) A capped major is one in which demand for that major outweighs available resources to meet the demand. As of Fall 2009, Mechanical and Aerospace Engineering became capped majors. As of Fall 2014, all engineering majors, including Environmental Engineering, became capped. This means that students will have to apply to declare these majors and admission is not guaranteed.

### Q) What if I want to switch into Mechanical, Aerospace, or Environmental Engineering?

A) Currently, continuing UCSD students who wish to change into an MAE major must apply during an application period. Applications for MAE majors are accepted every June. Admission into the majors is based entirely on grades and is limited by the amount of space available, which varies every year.

Continuing students who wish to be considered must submit an online application during the application period and must meet the following minimum requirements:

1. Completed at least one year (three quarters) in residence at UCSD.
2. Completed all course requirements for the major (see below).
3. Have a minimum 2.5 GPA.

**Freshmen** have two chances to apply. They can first apply after spring quarter of their first year at UCSD. To be eligible to apply, they need to have completed the following courses:

- MATH 20A-C
- PHYS 2A, 2B
- CHEM 6A

# MAE FAQ

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They can apply again after spring quarter of their second year at UCSD. To be eligible to apply, they need to have completed the following courses:

- MATH 20A-E and MATH 18
- PHYS 2A, 2B, and 2C
- CHEM 6A
- MAE 8 (MATLAB)

**Transfers** have one chance to apply: after spring quarter of their first year at UCSD. To be eligible to apply, they need to have completed the following courses:

- MATH 20A-E and MATH 18
- PHYS 2A, 2B, and 2C
- CHEM 6A
- MAE 8 (MATLAB)

Applicants will be ranked by their UCSD GPA and the grades they received in the criterion courses. **Admission is based on available space** and meeting eligibility requirements does not guarantee admission. Students should be aware that applications will be evaluated based on academic excellence. Students who apply later than the final day of their sixth academic quarter at UCSD will not be considered.

**It is not advised that a student follow any capped major curriculum. Deviation in ANY engineering major can delay your graduation by a year.**

## Other

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### Q) Which computer/ laptop should I buy?

A) Computer choice for students is a moving target, with the rapid changes in technology. The university provides computers in the labs and libraries but many students find benefits in having their own computers. Many students like the portability and long battery life of notebooks. These lower cost computers can run some engineering software such as Matlab, but they typically will not run Autodesk Inventor and ProE, which MAE students do use. One solution is to have both a notebook and a higher-powered laptop or desktop at home. One can use an Apple computer, but with a partition to run Windows programs, such as Inventor, ProE, and Labview. The computer requirements for Autodesk Inventor can be found at:

<http://www.autodesk.com/education/home>

### Q) Which engineering organizations can I get involved in as an engineering student?

A) Our engineering student organizations help students develop their leadership skills and connect with the Jacobs School of Engineering community. Activities range from professional development and career networking to project teams, design competitions and K-12 outreach. For a list of engineering student organizations that you can be involved in, please visit here:

[http://www.jacobsschool.ucsd.edu/student/student\\_involved/involved\\_org/](http://www.jacobsschool.ucsd.edu/student/student_involved/involved_org/)



# MAE COURSE DESCRIPTIONS

2020-2021

Please refer to the [Schedule of Classes](#) for the most up-to-date course information and prerequisites.

## Lower-Division

### **MAE 02. Introduction to Aerospace Engineering (4)**

An introduction to topics in aeronautical and astronautical engineering including aerodynamics, propulsion, flight mechanics, structures, materials, orbital mechanics, design, mission planning, and environments. General topics include historical background, career opportunities, engineering ethics, and professionalism. Must be taken for a letter grade. **Prerequisites:** none.

### **MAE 03. Introduction to Engineering Graphics and Design (4)**

Introduction to design process through a hands-on design project performed in teams. Topics include problem identification, concept generation, project management, risk reduction. Engineering graphics and communication skills are introduced in the areas of: Computer-Aided Design (CAD), hand sketching, and technical communication. **Prerequisites:** Physics 2A or 4A. Priority enrollment given to engineering majors.

### **MAE 05. Quantitative Computer Skills (4)**

Introductory course for non-engineering majors. Use of computers in solving problems; applications from life sciences, physical sciences, and engineering. Students run existing computer programs and complete some programming in BASIC.

**Prerequisites:** none.

### **MAE 07. Spatial Visualization (1)**

Spatial visualization is the ability to manipulate 2-D and 3-D shapes in one's mind. In this course, students will perform exercises that increase their spatial visualization skills. P/NP grades only. **Prerequisites:** none.

### **MAE 08. MATLAB Programming for Engineering Analysis (4)**

Computer programming in MATLAB with elementary numerical analysis of engineering problems. Arithmetic and logical operations, arrays, graphical presentation of computations, symbolic mathematics, solutions of equations, and introduction to data structures. **Prerequisites:** Math 20A and 20B or consent of instructor.

### **MAE 11. Thermodynamics (4)**

Fundamentals of engineering thermodynamics: energy, work, heat, properties of pure substances, first and second laws for closed systems and control volumes, gas mixtures. Application to engineering systems, power and refrigeration cycles, combustion. **Prerequisites:** Phys 2C and Chem 6A.

### **MAE 20. Elements of Materials Science (4)**

The structure of materials: metals, ceramics, glasses, semiconductors, superconductors, and polymers to produce desired, useful properties. Atomic structures. Defects in materials, phase diagrams, microstructural control. Mechanical and electrical properties are discussed. Time temperature transformation diagrams. Diffusion. **Prerequisites:** Phys 2A or 4A, Chem 6A or Chem 6AH, and Math 20C.

### **MAE 21. Aerospace Materials Science (4)**

Atomic structure and physical properties of engineering materials including metals, ceramics, glasses, polymers and composite materials. Defects and phase diagram of materials. Material testing and processing. **Prerequisites:** Phys 2A or Phys 4A, Chem 6A or Chem 6AH and Math 20B.

### **MAE 30A. Kinematics (4)**

Statics: Statics of Particles and Rigid Bodies in 3D. Free body diagrams. Moment of a force, couples, equivalent systems of forces. Distributed forces, centroids, and centers of gravity. Introduction to Dynamics: 3D relative motion, kinematics and kinetics of particles. Newton's equations of motion. Equilibrium problems with friction. **Prerequisites:** Phys 2A and Math 20C or MATH 31BH.

**MAE 30B. Dynamics and Vibrations (4)**

Dynamics: Energy methods for motion of particles and rigid bodies, including virtual work, power, and Lagrange's equations. Impact and impulses. Systems of particles. Introduction to 3-D dynamics of rigid bodies. Introduction to Vibrations: Free and harmonically forced vibrations of undamped and damped single degree of freedom systems. **Prerequisites:** MAE 30A

**MAE 40. Linear Circuits (4)**

Steady-state and dynamic behavior of linear, lumped-parameter electrical circuits. Kirchoff's laws. RLC circuits. Node and mesh analysis. Operational amplifiers. Signal acquisition and conditioning. Electric motors. Design applications in engineering.

**Prerequisites:** admission to the engineering major. Math 20D or 21D, Math 18, and Phys 2B.

**MAE 87. Freshman Seminar (1)**

The Freshman Seminar program is designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman Seminars are offered in all campus departments and undergraduate colleges. Topics vary from quarter to quarter. Enrollment is limited to fifteen to twenty students, with preference given to entering freshmen. **Prerequisites:** none.

**MAE 92A. Design Competition—Design, Build, and Fly Aircraft (1)**

(Cross-listed with SE 10A.) Student teams design, build, and fly unmanned aircraft for a national student competition. Students concentrate on vehicle system design including aerodynamics, structures, propulsion, and performance. Teams engineer, fabricate the aircraft, submit a design report, and prep aircraft for competition. **Prerequisites:** consent of instructor.

**MAE 93. Design Competition—Design, Build, and Test Race Car (1)**

Student teams design, build, and test a formula-style racing car for an international student competition. Students concentrate on vehicle system analysis and design, manufacturability, and performance. Teams engineer, fabricate car, submit a design report, and prep car for competition. **Prerequisites:** consent of instructor.

**MAE 98. Directed Group Study (2)**

Directed group study on a topic or in a field not included in the regular departmental curriculum. P/NP grades only. May be taken for credit two times. Credit may not be received for a course numbered 97, 98, or 99 subsequent to receiving credit for a course numbered 197, 198, or 199. **Prerequisites:** consent of instructor.

**Upper-Division****MAE 101A. Introductory Fluid Mechanics (4)**

Fluid statics; fluid kinematics; integral and differential forms of the conservation laws for mass, momentum, and energy; Bernoulli equation; potential flows; dimensional analysis and similitude. **Prerequisites:** admission to an engineering major and Phys 2A, Math 20D or 21D and Math 20E, or consent of instructor.

**MAE 101B. Advanced Fluid Mechanics (4)**

Laminar and turbulent flow. Pipe flow including friction factor. Boundary layers, separation, drag, and lift. Compressible flow including shock waves. **Prerequisites:** MAE 101A and MAE 11, or consent of instructor.

**MAE 101C. Heat Transfer (4)**

Extension of fluid mechanics in MAE 101A–B to viscous, heat-conducting flows. Application of the energy conservation equation to heat transfer in ducts and external boundary layers. Heat conduction and radiation transfer. Heat transfer coefficients in forced and free convection. Design applications. **Prerequisites:** MAE 101A and MAE 105, or consent of instructor.

**MAE 101D. Intermediate Heat Transfer (4)**

Course builds on the MAE fluids sequence, offering more advanced concepts in conduction, convection, radiation, and heat exchanger design. This course covers numerical methods in conduction, boiling, condensation and evaporation analysis, natural and turbulent convection, spectral and directional radiative transfer; heatpipes, thermal design of spacecraft; heat exchanger analysis and design. **Prerequisites:** MAE 101C.

**MAE 104. Aerodynamics (4)**

Basic relations describing flow field around wings and bodies at subsonic and supersonic speed. Thin-wing theory. Slender-body theory. Formulation of theories for evaluating forces and moments on airplane geometries. Application to the design of high-speed airplanes. **Prerequisites:** open to MC 25, MC 27, MC 30-34 and SE 27 only. MAE 101A and 101B, or consent of instructor.

**MAE 105. Introduction to Mathematical Physics (4)**

Fourier series, Sturm Liouville theory, elementary partial differential equations, integral transforms with applications to problems in vibration, wave motion, and heat conduction. **Prerequisites:** admission to engineering major. Phys 2A and B, and Math 20D or 21D.

**MAE 107. Computational Methods in Engineering (4)**

Introduction to scientific computing and algorithms; iterative methods, systems of linear equations with applications; nonlinear algebraic equations; function interpolation and differentiation and optimal procedures; data fitting and least-squares; numerical solution of ordinary differential equations. **Prerequisites:** MAE 8 and Math 18.

**MAE 108. Probability and Statistical Methods for Mechanical and Environmental Engineering (4)**

Probability theory, conditional probability, Bayes theorem, random variables, densities, expected values, characteristic functions, central limit theorem. Engineering reliability, elements of estimation, random sampling, sampling distributions, hypothesis testing, confidence intervals. Curve fitting and data analysis. **Prerequisites:** Math 18.

**MAE 110: Thermodynamics Systems (4)**

Thermodynamic analysis of power cycles with application to combustion driven engines: internal combustion, diesel, and gas turbines. Thermodynamics of mixtures and chemical and phase equilibrium. Computational methods for calculating chemical equilibrium. Renumbered from MAE 110B. Students may not receive credit for MAE 110 and MAE 110B. **Prerequisites:** MAE 11 or 110A. (Course not offered every year.)

**MAE 113. Fundamentals of Propulsion (4)**

Compressible flow, thermodynamics, and combustion relevant to aircraft and space vehicle propulsion. Analysis and design of components for gas turbines, including turbines, inlets, combustion chambers and nozzles. Fundamentals of rocket propulsion. **Prerequisites:** open to MC 25, MC 27, and MC 30-34 only. MAE 11, and MAE 101A, and MAE 101B.

**MAE 117A. Elementary Plasma Physics (4)**

(Cross-listed with Physics 151.) Particle motions, plasmas as fluids, waves, diffusion, equilibrium and stability, nonlinear effects, controlled fusion. Recommended preparation: Phys 100B-C or ECE 107. **Prerequisites:** Math 20D or 21D, or consent of instructor.

**MAE 118. Introduction to Energy Systems (4)**

Overview of present day primary energy sources and availability; fossil fuel, renewable, and nuclear; heat engines; energy conservation, transportation, air pollution, and climate change. Students may not receive credit for both MAE 118 and MAE 118A. **Prerequisites:** MAE 101A, or consent of instructor.

**MAE 119. Introduction to Renewable Energy: Solar and Wind (4)**

Basic principles of solar radiation—diffuse and direct radiation; elementary solar energy engineering—solar thermal and solar photovoltaic; basic principles of wind dynamics—hydrodynamic laws, wind intermittency, Betz's law; elementary wind energy engineering; solar and wind energy perspectives; operating the California power grid with 33 percent renewable energy sources. Students may not receive credit for both MAE 118B and MAE 119. **Prerequisites:** MAE 101A or CENG 101A, or consent of instructor.

**MAE 120. Introduction to Nuclear Energy (4)**

Overview of basic fission and fusion processes. Elementary fission reactor physics and engineering; environmental and waste disposal issues. Survey of fusion technology issues and perspectives. May not receive credit for both MAE 118C and MAE 120. **Prerequisites:** MAE 101A or CENG 101A, or consent of instructor.

**MAE 122. Flow and Transport in the Environment (4)**

Introduction to the air and aquatic environments. Buoyancy, stratification, and rotation. Earth surface energy balance. Introduction to the atmospheric boundary layer. Advection and diffusion. Turbulent diffusion and dispersion in rivers and in the atmospheric boundary layer. Surface waves and internal gravity waves. **Prerequisites:** MAE 101A or CENG 101A, or consent of instructor.

**MAE 123. Introduction to Transport in Porous Media (4)**

Introduction to groundwater flow. Pollution transport through the water table. Fundamentals of flow. Single- and multi-phase flow. Darcy law. Well hydraulics. Diffusion and dispersion. Gravity currents and plumes in porous media. Chemistry of fluid-solid interactions. Fundamentals of adsorption and surface reactions. **Prerequisites:** MAE 105.

**MAE 124. Environmental Challenges: Science and Solutions (4)**

(Cross-listed with ESYS 103.) This course explores the impacts of human social, economic, and industrial activity on the environment. It highlights the central roles in ensuring sustainable development played by market forces, technological innovation and governmental regulation on local, national, and global scales. **Prerequisites:** Math 20B or Math 10A-C, or consent of instructor.

**MAE 125. Building Energy Efficiency (4)**

Physical building performance including building thermodynamics, daylighting, and solar control. Heat transfer through building envelope, solar geometry, and shading. Heating, ventilation, and air conditioning system design, water heating, microclimates, passive system design, energy efficient design, applicant energy use, cost estimating. Building energy codes and standards. Building design project with whole building energy simulation software. **Prerequisites:** upper-division standing.

#### **MAE 126A. Environmental Engineering Laboratory (4)**

Analysis of experiments in Environmental Engineering: Drag in a water tunnel, shading effects on solar photovoltaic, buoyant plume dispersion in a water tank, atmospheric turbulence, and others. Use of sensors and data acquisition. Laboratory report writing; error analysis; engineering ethics. **Prerequisites:** MAE 101A or CENG 101A; MAE 170 and MAE 122.

#### **MAE 126B. Environmental Engineering Design (4)**

Fundamental principles of environmental design. Building a working prototype or computer model for an environmental engineering application. Work in teams to propose and design experiments and components, obtain data, complete engineering analysis, and write a report. Engineering ethics and professionalism. **Prerequisites:** MAE 126A.

#### **MAE 130. Advanced Vibrations (4)**

Harmonically excited vibrations. Vibration of multiple degree-of-freedom systems. Observations, including beat frequencies, static and dynamic coupling, traveling and standing wave phenomena. Vibration of continuous systems. Hamilton's equations. Distributed and point forces and moments in continuous systems and the generalized Dirac distribution. Response to impact and impulse excitation. Modeling continuous systems with approximate discrete models. **Prerequisites:** Math 18 or Math 20F or Math 31AH and MAE 130B or MAE 30B.

#### **MAE 131A. Solid Mechanics I (4)**

(Cross-listed with SE 110A.) Students may not receive credit for SE 110A or MAE 131A and SE 110A/MAE 131A. Concepts of stress and strain. Hooke's Law. Axial loading of bars. Torsion of circular shafts. Shearing and normal stresses in beam bending. Deflections in beams. Statically determinate and indeterminate problems. Combined loading. Principal stresses and design criteria. Buckling of columns. **Prerequisites:** Math 20D, and MAE 30A or SE 101A.

#### **MAE 131B. Fundamentals of Solid Mechanics II (4)**

Continuous mechanics of solids and its application to the mechanical response of machine and structural elements. Stress and strain in indicial notation; field equations and constitutive relations. Linear elastic stress analysis in torsion, plane stress and plane strain; stress concentrations; fracture mechanics. Extremum principles and structural stability. Viscoelasticity, plasticity, and failure criteria. Theorems of plastic limit analysis. **Prerequisites:** MAE 131A or SE 110A, and MAE 105, and admission to engineering major.

#### **MAE 133. Finite Element Methods in Mechanical and Aerospace Engineering (4)**

Development of stiffness and mass matrices based upon variational principles and application to static, dynamic, and stability design problems in structural and solid mechanics. Architecture of computer codes for linear and nonlinear finite element analysis and basic computer implementation. The use of general purpose finite element structural analysis computer codes. **Prerequisites:** MAE 131A or SE 110A.

#### **MAE 142. Dynamics and Control of Aerospace Vehicles (4)**

The dynamics of vehicles in space or air are derived for analysis of the stability properties of spacecraft and aircraft. The theory of flight, lift, drag, dutch roll and phugoid modes of aircraft are discussed. Optimal state space control theory for the design of analog and digital controllers (autopilots). **Prerequisites:** admission to the engineering major. MAE 104 and MAE 143B or ECE 171A, or consent of instructor.

#### **MAE 143A. Signals and Systems (4)**

Dynamic modeling and vector differential equations. Concepts of state, input, output. Linearization around equilibria. Laplace transform, solutions to ODEs. Transfer functions and convolution representation of dynamic systems. Discrete signals, difference equations, z-transform. Continuous and discrete Fourier transform. **Prerequisites:** Math 20D or 21D, Math 20E, Math 18, or consent of instructor.

#### **MAE 143B. Linear Control (4)**

Analysis and design of feedback systems in the frequency domain. Transfer functions. Time response specifications. PID controllers and Ziegler-Nichols tuning. Stability via Routh-Hurwitz test. Root locus method. Frequency response: Bode and Nyquist diagrams. Dynamic compensators, phase-lead and phase-lag. Actuator saturation and integrator wind-up. **Prerequisites:** MAE 143A or CENG 100, or consent of instructor.

#### **MAE 144. Embedded Control and Robotics (4)**

Each student builds, models, programs, and controls an unstable robotic system built around a small Linux computer. Review/synthesis of: A) modern physical and electrical CAD. B) dynamics, signals and systems, linear circuits; PWMs, H-bridges, quadrature encoders. C) embedded Linux, C, graphical programming; multithreaded applications; bus communication

to supporting ICs. D) classical control theory in both continuous-time (CT) and discrete-time (DT); interconnection of CT and DT elements. Program or material fee may apply. Students may not receive credit for both MAE 144 and MAE 143C. **Prerequisites:** upper-division standing or graduate student, and MAE 143B, or consent of instructor.

#### **MAE 145. Introduction to Robotic Planning and Estimation (4)**

This course is an introduction to robotic planning algorithms and programming. Topics: sensor-based planning (bug algorithms), motion planning via decomposition and search (basic search algorithms on graphs, A\*), the configuration-space concept, free configuration spaces via sampling, collision detection algorithms, (optimal) planning via sampling (probabilistic trees), environment roadmaps, and (extended) Kalman filtering for robot localization and environment mapping (SLAM). **Prerequisites:** senior standing or consent of instructor.

#### **MAE 148. Introduction to Autonomous Vehicles (4)**

Fundamentals of Autonomous Vehicles. Working in small teams, students will develop 1/8 scale autonomous cars that must perform on a simulated city track. Topics include: Robotics System Integration, Computer Vision, Algorithms for Navigation, On-vehicle vs. off-vehicle computation, Computer Learning Systems such as Neural Networks, Locomotion Systems, Vehicle Steering, Dead Reckoning, Odometry, Sensor Fusion, GPS Auto-Pilot limitations, Wiring, and Power Distribution and Management. **Prerequisites:** ECE 15 or ECE 35 or MAE 2 or MAE 3.

#### **MAE 149. Sensor Networks (4)**

(Cross-listed with ECE 156 and SIO 238.) Characteristics of chemical, biological, seismic and other physical sensors; signal processing techniques supporting distributed detection of salient events; wireless communication and networking protocols supporting formation of robust sensor fabrics; current experience with low power, low-cost sensor deployments.

**Prerequisites:** upper-division standing and consent of instructor, or graduate student in science or engineering.

#### **MAE 150. Computer-Aided Design (4)**

Computer-aided analysis and design. Design methodology, tolerance analysis, Monte Carlo analysis, kinematics and computer-aided design of linkages, numerical calculations of moments of inertia, design of cams and cam dynamics; finite element analysis, design using Pro-E, Mechanica Motion and Mechanica Structures. **Prerequisites:** MAE 30A or SE 101A or BENG 110, MAE 107 or SE 121, MAE 3, and senior standing in engineering major, or consent of instructor.

#### **MAE 154. Product Design and Entrepreneurship (4)**

This course will teach teams of students how to develop concepts and business plans in the design of new and innovative products. Emphasis will be placed on identifying user needs, concept generation, and prototype fabrication. **Prerequisites:** upper-division standing and consent of instructor.

#### **MAE 155A. Aerospace Engineering Design I (4)**

Fundamental principles of aerospace vehicle design including the conceptual, preliminary, and detailed design phases. Aeronautical or astronautical design project that integrates all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting, and professionalism. **Prerequisites:** MAE 2, MAE 104, MAE 30B, MAE 21 or SE 2/L, and SE 160B, or consent of instructor.

#### **MAE 155B. Aerospace Engineering Design II (4)**

Fundamental principles of aerospace vehicle design including the conceptual, preliminary, and detailed design phases. Aeronautical or astronautical design project that integrates all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting, and professionalism. Program or material fee may apply.

**Prerequisites:** MAE 113, MAE 142, MAE 155A, and MAE 170, or consent of instructor.

#### **MAE 156A. Fundamental Principles of Mechanical Design I (4)**

Fundamental principles of mechanical design and the design process. Application of engineering science to the design and analysis of mechanical components. Initiation of team design projects that culminate in MAE 156B with a working prototype designed for a real engineering application. Professional ethics discussed. Program or material fee may apply. **Prerequisites:** MAE 3, MAE 30B, MAE 131A, MAE 150, and MAE 170, or consent of instructor. Open to major code MC 27 and MC 30-34 only.

#### **MAE 156B. Fundamental Principles of Mechanical Design II (4)**

Fundamental principles of mechanical design and the design process. Culmination of a team design project initiated in MAE 156A which results in a working prototype designed for a real engineering application. **Prerequisites:** MAE 156A in the immediately preceding quarter, MAE 101C, MAE 143B, and MAE 131B or MAE 160, or consent of instructor. Open to major code MC 27 and MC 30-34 only.

#### **MAE 160. Mechanical Behavior of Materials (4)**

Elasticity and inelasticity, dislocations and plasticity of crystals, creep, and strengthening mechanisms. Mechanical behavior of ceramics, composites, and polymers. Fracture: mechanical and microstructural. Fatigue. Laboratory demonstrations of selected topics. **Prerequisites:** MAE 20, MAE 30A (or SE 101A) and MAE 131A, or consent of instructor.

**MAE 165. Fatigue and Failure Analysis of Engineering Components (4)**

The engineering and scientific aspects of crack nucleation, slow crack growth, and unstable fracture in crystalline and amorphous solids. Microstructural effects on crack initiation, fatigue crack growth and fracture toughness. Methods of fatigue testing and fracture toughness testing. Fractography and microfractography. Design safe methodologies and failure prevention. Failure analysis of real engineering structures. **Prerequisites:** consent of instructor. Not offered every year.

**MAE 166. Nanomaterials (4)**

(Cross-listed with NANO 156.) Basic principles of synthesis techniques, processing, microstructural control and unique physical properties of materials in nanodimensions. Nanowires, quantum dots, thin films, electrical transport, optical behavior, mechanical behavior, and technical applications of nanomaterials. **Prerequisites:** upper-division standing. (Not offered every year.)

**MAE 170. Experimental Techniques (4)**

Principles and practice of measurement and control and the design and conduct of experiments. Technical report writing. Lectures relate to dimensional analysis, error analysis, signal-to-noise problems, filtering, data acquisition and data reduction, as well as background of experiments and statistical analysis. Experiments relate to the use of electronic devices and sensors. **Prerequisites:** Phys 2C and Phys 2CL or MAE 40

**MAE 171A. Mechanical Engineering Laboratory I (4)**

Design and analysis of experiments in fluid mechanics, solid mechanics, and control engineering. Experiments in wind tunnel, water tunnel, vibration table and material testing machines, and refined electromechanical systems. Laboratory report writing; error analysis; engineering ethics. **Prerequisites:** MAE 101A and MAE 170.

**MAE 175A. Aerospace Engineering Laboratory I (4)**

Analysis of aerospace engineering systems using experimental facilities in undergraduate laboratories: wind tunnel, water channel, vibration table, and testing machine. Students operate facilities, obtain data, complete engineering analysis and write major reports. **Prerequisites:** MAE 101C or CENG 101B; MAE 143B or CENG 120 and MAE 170, or consent of instructor.

**MAE 180A. Spacecraft Guidance I (4)**

Astrodynamics, orbital motion, perturbations, coordinate systems and frames of reference. Geosynchronous orbits, stationkeeping. Orbital maneuvers, fuel consumption, guidance systems. Observation instrument point, tracking, control. Basic rocket dynamics. Navigation, telemetry, re-entry, and aero-assisted maneuvers. Mission design. Students perform analyses based on mission requirements. **Prerequisites:** upper-division standing in physics, mathematics, or engineering department.

**MAE 181. Space Mission Analysis and Design (4)**

Space mission concepts, architectures, and analysis. Mission geometry. Astrodynamics. Orbit and constellation design. Space environment. Payload and spacecraft design and sizing. Power sources and distribution. Thermal management. Structural design. Guidance and navigation. Space propulsion. Orbital debris and survivability. Cost modeling and risk analysis. **Prerequisites:** upper-division standing or consent of instructor.

**MAE 190: Topics in Mechanical and Aerospace Engineering (4)**

Topics of special interest in mechanical and aerospace engineering.

**MAE 191: Topics in Mechanical and Aerospace Engineering with Laboratory (4)**

Topics in Mechanical and Aerospace Engineering with Laboratory

**MAE 192. Senior Seminar in Aerospace, Environmental or Mechanical Engineering (1)**

The Senior Seminar Program is designed to allow senior undergraduates to meet with faculty members in a small group setting to explore an intellectual topic in aerospace, environmental or mechanical engineering (at the upper-division level). Topics will vary from quarter to quarter. Senior Seminars may be taken for credit up to four times, with a change in topic and permission from the department. Enrollment is limited to twenty students, with preference given to seniors. **Prerequisites:** department stamp or consent of instructor.

**MAE 197. Engineering Internship (1-12)**

Students work in local industry or hospitals under faculty supervision. Units may not be applied toward graduation requirements. Salaried or unsalaried. Number of units determined by enrollment frequency. First quarter up to four units. Subsequent quarters cannot exceed one unit. **Prerequisites:** consent of instructor and department stamp, 2.50 overall GPA minimum, at least ninety units.

**MAE 198. Directed Group Study (1-4)**

Directed group study on a topic or in a field not included in the regular department curriculum, by special arrangement with a faculty member. May be taken P/NP only. **Prerequisites:** consent of instructor.

**MAE 199. Independent Study for Undergraduates (4)**

Independent reading or research on a problem by special arrangement with a faculty member. P/NP grades only.

**Prerequisites:** consent of instructor.

# STUDENT AFFAIRS CONTACT LIST

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